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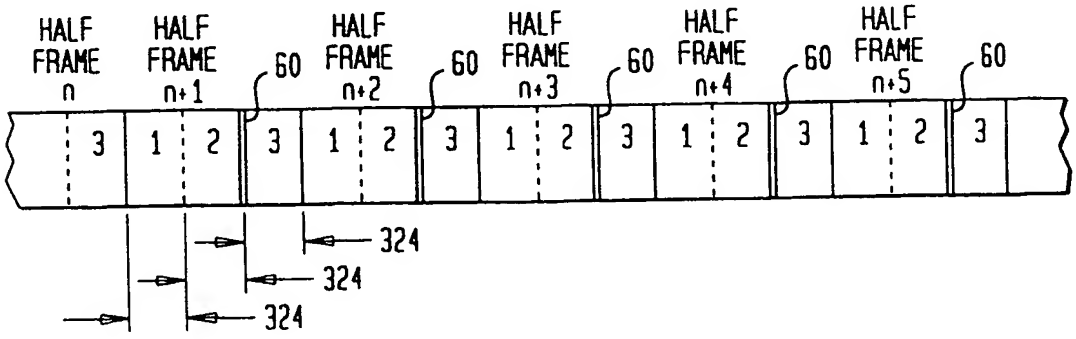
(54) TDMA system with discontinuous transmission

(57) Alternative messages are transmitted in a time slot (e.g.3) of a frame of a time division multiple access communications system during periods of silence or when no speech data is present. When an absence of voice is detected, an abbreviated message (60) is substituted for a longer message in the time slot (31). In subsequent frames, the shorter message (60) is also substituted for the longer message until voice is detected.

FIG. 3



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Description

Related Application

This application is related to the concurrently filed and commonly assigned application entitled "Method For Channel Management In A TDMA Communication System," Serial No. _____ .

Background of the Invention

1. Field of the Invention

The present invention relates to communications; more specifically, wireless communications.

2. Description of the Related Art

In a TDMA (Time Division Multiple Access) system, communication channels between a base station and a mobile communication device are defined in terms of a frequency and time slot. Each communication channel is assigned to a frequency and one of multiple time slots transmitted on a given frequency. In the case of systems adhering to TIA (Telecommunications Industry Association) Standard IS-136.2, three time slots are associated with each frequency. As a result, three channels are assigned to each frequency.

FIG. 1 illustrates an arrangement of time slots as defined by Standard IS-136.2. A sequence of frames is transmitted where each frame contains six time slots. Each time slot contains the data associated with a communication channel. The half-frames contain 60 milliseconds of information where each time slot contains 20 milliseconds of information. Each time slot contains 324 bits. As a result, for a given communication channel, 324 bits of information are transmitted each half-frame.

FIG. 2 illustrates the different fields associated with the 324 bits from one of the slots of FIG. 1. The fields are defined by Standard IS-136.2. Field 40 is labeled G and is used as a guard field between slots and contains 6 bits. Field 42 is a ramp field having 6 bits which are used to provide time for a mobile transmitter to reach full operating power after being off for the previous slots. DATA field 44 is 16 bits long and is used to transmit data. SYNC field 46 is 28 bits long and is used to transmit a synchronization pattern. DATA field 48 is 122 bits long and is used to transmit data, SACCH field 50 is 12 bits long and is used to transmit the SACCH message (Slow Associated Control Channel). This field is used to exchange signaling messages between the base station and mobile device. These signaling messages include information regarding the quality of the channel. CDVCC field 52 is 12 bits long and is used to transmit the CDVCC message (Coded Digital Verification Color Code). This channel is used to indicate that the base station and mobile device are exchanging proper data. DATA field 54 is 122 bits long and is used to transmit data. The data fields are typically used to carry information such as speech data. The Standard also permits replacing data fields 48 and 54 with a FACCH field (Fast Associated Control Channel) message. This message is used to exchange information between the mobile and base station in situations such as handoffs. It should be noted that during this time the voice data is blanked so that the signaling message may be passed between the mobile and base station.

Communications between a base station and a mobile communication device include messages containing data corresponding to speech. In many conversations, it is typical for moments of silence to occur. As a result, messages carried between the base station and mobile device are carrying data representative of silence. This is wasteful because mobile unit battery power is being used to transmit information representative of silence, and in addition, other channels are receiving interference from a channel that is only transmitting data indicative of silence.

One suggested solution to avoid wasting transmissions by sending data representative of silence or absence of voice is to stop transmitting in periods of silence except for transmissions containing information relating to channel quality. In a one second period of relative silence, only three transmissions rather than 50 transmissions would be sent. The three transmissions are in the 324 bit form of FIG. 2 and contain the channel quality information in DATA fields 44, 48, and 54. This solution offers the advantage of reducing co-channel interference and reducing battery drain at the mobile; however, it creates a problem for the party receiving the message. The party receiving the message will simply hear silence as opposed to background noise when no transmissions are made. This may make the users feel as if the call has been dropped when in reality it is simply a silence transmission.

A second suggested solution addresses this problem. Once again, a period of silence is detected using a voice activity detector, and transmission stops except for five transmissions per second. The five transmissions are in the 324 bit form of FIG. 2. Three of the five transmissions are used to transmit channel quality information in DATA fields 44, 48, and 54. The remaining two transmissions are used to transmit comfort noise information in same DATA fields. Comfort noise information is information representative of background noise that is transmitted to a receiver. The receiver uses the comfort noise information to generate background noise that a user may hear. As a result, in periods of silence a user still can hear background noise and therefore be assured that the communication channel has not been interrupted.

Both of these solutions suffer from the same problem. They both make it difficult for a base station to monitor channel quality when choosing an available channel for assignment to a new call. It should be noted that during a period of silence, the transmitter at the mobile is

turned off for a large majority of the time (45 out of 50 possible transmission times). When the base station makes an interference measurement, it may get a false low interference reading based on a mobile that is temporarily not transmitting. As a result, the base station may assign a low quality channel to a new call.

Summary of the Invention

An embodiment of the present invention solves the aforementioned problems by continuing to transmit in each time slot during periods of silence; however, the number of bits transmitted in the time slot is reduced to save battery power and to limit interference in other channels. The reduced number of bits are used to carry channel quality information and comfort noise information. As a result, this embodiment of the present invention allows transmission of comfort noise during periods of silence and still allows an accurate measurement of interference when assigning a channel to a new call.

Brief Description of the Drawings

FIG. 1 illustrates a series of half-frames associated with a single frequency of a TDMA system;
FIG. 2 illustrates the fields of one of the time slots of FIG. 1;
FIG. 3 illustrates several half-frames with time slot 3 carrying a message associated with a period of silence;
FIG. 4 illustrates the fields of an abbreviated message;
FIG. 5 illustrates the fields of another abbreviated message format; and
FIG. 6 illustrates several half-frames with time slot 3 carrying difference abbreviated messages.

Detailed Description of the Invention

FIG. 3 illustrates a sequence of half-frames for a particular frequency in a TDMA system. Each half-frame is broken into three time slots where each slot is associated with a communication channel. If, for example, slots 1 and 2 are not transmitting periods of silence, the full 324 bits associated with the slot are transmitted. If the communication channel using time slot 3 is in a period of silence, only 80 bits of information are transmitted during the time slot. This is illustrated by shaded region 60 in each time slot 3. As a result, there remains only a small portion of time slot 3 used for actual transmission. During the remaining portion of time slot 3, no transmissions are present and as a result, power drain and co-channel interference are reduced. In this example, the width of shaded region 60 is only 80 bits. However, the width of region 60 may be increased or decreased by transmitting more bits or less bits, respectively.

FIG. 4 illustrates the fields that are transmitted when periods of silence are detected. A time slot will still be 324 bits long, however, only 80 bits will be transmitted. This provides a reduction of power thereby increasing battery life and also reducing co-channel interference. When periods of silence are detected, the 80 bits of FIG. 4 are transmitted instead of 324 bits of FIG. 2. Once again, field 70 is a guard field of 6 bits and field 72 is a ramp field of 6 bits. Field 74 is a data field containing 16 bits and field 76 is a synchronization field containing 28 bits. Field 78 carries an SACCH message and is 12 bits long. Field 80 is 12 bits long and contains the CDVCC message. When silence or absence of voice is detected, either the mobile or base station transmits the 80 bit field and places the channel quality information in field 78 as an SACCH message and places the comfort noise in field 74. The 80 bits of FIG. 4 are transmitted in each time slot associated with the communication channel.

Since a transmission is made during each time slot associated with the communication channel, when co-channel interference is measured, the measurements are made using samples from the first part of the time slot so as to get an accurate measurement of interference.

It should be noted that the number of bits transmitted during a period of silence need not be limited to 80 bits and need not be limited to the fields specified in FIG. 4. For example, it is possible to vary the number of bits associated with each field or to add or subtract fields from those shown in FIG. 4. For example, FIG. 5 illustrates sending additional data field 92 after the CDVCC field. It is also possible to place comfort noise information in data field 90 of FIG. 5 while placing fax or modem data in data field 92. Recalling FIG. 4, it is also possible to transmit the comfort noise information in field 74 for a portion of the time and to send other types of data in data field 74 the rest of the time. For example, use of data field 74 may be used for different purposes in different half-frames. FIG. 6 illustrates half-frames N, N+1, N+2, and N+3. Each half-frame contains three time slots. In this example we are assuming the channel associated with time slot 3 is transmitting silence and therefore an abbreviated message is being transmitted in place of the usual longer message. This shortened amount of data or number of bits is indicated by shaded area 100. In half-frame N, comfort noise data may be transmitted in field 74. In half-frames N+1 additional comfort noise data may be transmitted while in half-frames N+2 and N+3 data associated with a fax, a modem, or e-mail may be transmitted. It is possible to transmit as few as 1 or 2 half-frames containing comfort noise per second while using the other half-frames to transmit other information. For example, two out of 50 half-frames per second may be used to transmit comfort noise while the remaining 48 half-frames may be used for transmitting other data.

Claims

1. A method for transmitting alternative messages in a time slot of a frame of a time division multiple access communications system, the method comprising the steps of:

   detecting an absence of voice;
   substituting an abbreviated message for a longer message in the time slot; and
   continuing to substitute the abbreviated message for the longer message until voice is detected.

2. The method of claim 1, further comprising the step of including comfort noise information in the abbreviated message.

3. The method of claim 1, further comprising the step of including channel quality information in the abbreviated message.

4. The method of claim 3, further comprising the step of including comfort noise information in the abbreviated message.

5. A method for transmitting alternative messages in a time slot of a frame of a time division multiple access communications system, the method comprising the steps of:

   detecting an absence of voice;
   substituting a first shorter format message for a longer format message in the time slot of a first frame;
   substituting a second shorter format message for a longer message in the time slot of a second frame; and
   continuing to substitute at least one of the shorter format messages for a longer format message until voice is detected.

6. The method of claim 5, wherein the first shorter format message contains a different type of information than the second shorter format message.

7. The method of claim 6, wherein the first shorter format message includes comfort noise information.

8. The method of claim 7, wherein the second shorter format message includes fax data.

9. The method of claim 7, wherein the second shorter format message includes modem data.

10. The method of claim 7, wherein the second shorter format message includes channel quality data.

11. The method of claim 7, wherein the second shorter format message includes channel quality data and comfort noise information.

12. A method for transmitting alternative messages in a time slot of a frame of a time division multiple access communications system, the method comprising the steps of:

    detecting an absence of voice;
    substituting a shorter format message for a longer format message in the time slot; and
    continuing to substitute the shorter format message for a longer format message until voice is detected, the shorter format message having a 16 bit data field, a 28 bit synchronization field, and a 12 bit SACCH field.

13. The method of claim 12, wherein the shorter format message comprises at least 80 bits.

14. The method of claim 12, wherein the shorter format message comprises a 6 bit ramp field.

15. The method of claim 12, wherein the shorter format message comprises less than 324 bits.

FIG. 1
(PRIOR ART)

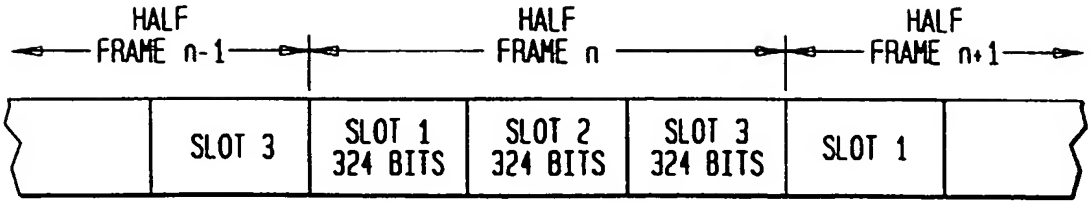


FIG. 2
(PRIOR ART)

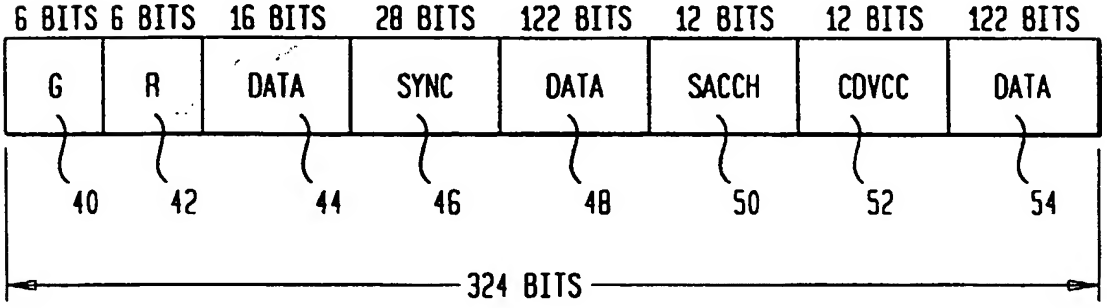


FIG. 3

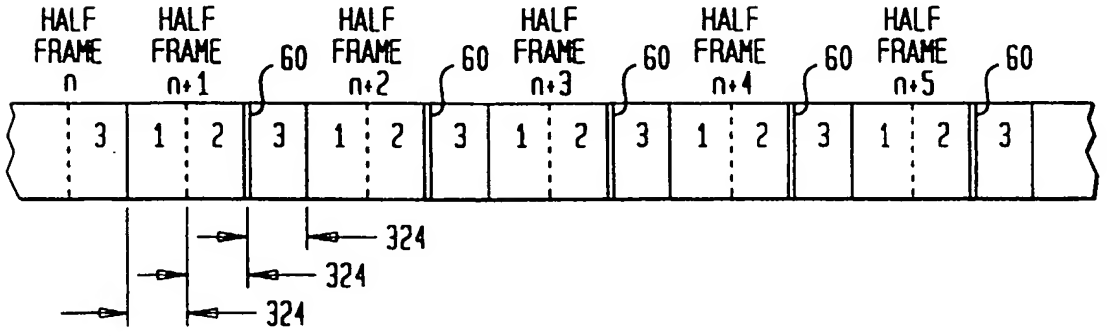


FIG. 4

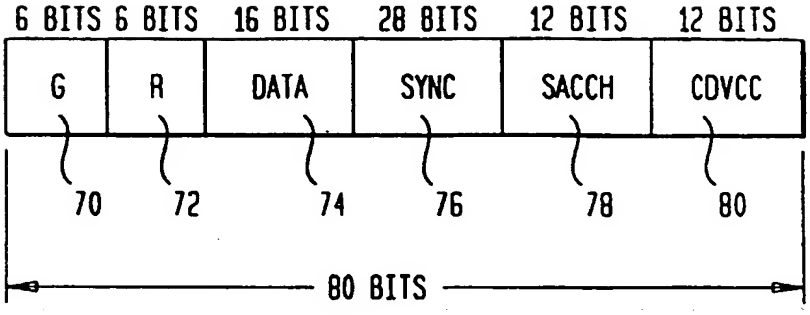


FIG. 5

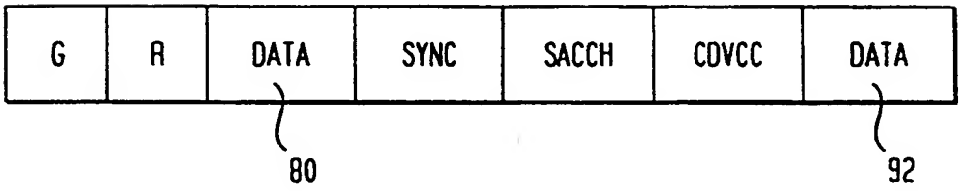
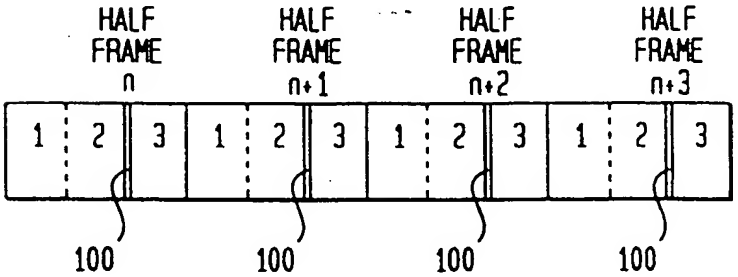


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 1801

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 290 198 A (NIPPON ELECTRIC CO) 13 December 1995 * page 3, line 20 - page 4, line 9 * * page 4, line 24 - page 6, line 10 * * page 7, line 15 - page 8, line 18 * * figure 1 *	1,2, 12-15 3 5	H04B7/26
Y	US 5 581 548 A (UGLAND JON K ET AL) 3 December 1996 * column 15, line 17 - column 16, line 42 * * column 19, line 14 - line 26 *	3	
A	WO 91 02436 A (TELECOM SEC CELLULAR RADIO LTD) 21 February 1991 * page 1, line 1 - page 2, line 15 *	1-15	
A	WO 96 33585 A (ERICSSON GE MOBILE INC) 24 October 1996 * page 1, line 1 - page 2, line 30 * * page 3, line 7 - line 18 *	2,4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H04B
H04Q
H04J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 June 1998	Casals Castañé, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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